

Attachments 2 through 7 to the Enclosure contain Proprietary Information –
Withhold Under 10 CFR 2.390

Attachment 12
PG&E Letter DCL-14-028

AREVA Calculation No. 32-9219813-000

**Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle
Weld Overlay Residual Stress Analysis – Non-Proprietary**

**CALCULATION SUMMARY SHEET (CSS)**Document No. 32 - 9219813 - 000Safety Related: ☒ Yes ☐ NoTitle Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis – Non-Proprietary**PURPOSE AND SUMMARY OF RESULTS:**

The purpose of this report is to document the weld residual stress finite element analysis of the pressurizer safety/relief nozzles of Diablo Canyon Unit 2 in support of the planned preemptive mitigation of primary water stress corrosion cracking (PWSCC) susceptible Alloy 82/182 dissimilar metal welds using PWSCC resistant [] full structural weld overlays (SWOL). The state of stresses at shutdown (70°F) and steady state ([] °F) after the completion of the SWOL, as predicted by the ANSYS Version 10.0 finite element analysis, are summarized to support flaw evaluations of the pressurizer safety/relief nozzle design.

This document is the Non-Proprietary document for 32-9049062-004.

Proprietary information is contained within bold square brackets "[]".

THE FOLLOWING COMPUTER CODES HAVE BEEN USED IN THIS DOCUMENT:

CODE/VERSION/REV	CODE/VERSION/REV
<u>ANSYS Version 10.0 (Earlier Versions) / (OS not known)</u>	<u>ANSYS Version 14.0 (Current Revision) / Windows 7</u>
_____	_____

THE DOCUMENT CONTAINS
ASSUMPTIONS THAT SHALL BE
VERIFIED PRIOR TO USE

☐ YES
☒ NO



Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis – Non-Proprietary

Review Method: ☒ Design Review (Detailed Check)
☐ Alternate Calculation

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N/A				
N/A				

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Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis – Non-Proprietary

Record of Revision

Revision No.	Pages/Sections/Paragraphs Changed	Brief Description / Change Authorization
000	All	Original Release
000	All	Non-Proprietary document for 32-9049062-004

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Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis – Non-Proprietary

1.0 PURPOSE

Alloy 600 and its associated weldments Alloy 82/182 are susceptible to primary water stress corrosion cracking (PWSCC). Pacific Gas and Electric plans to mitigate PWSCC in the Diablo Canyon Unit 2 pressurizer nozzle Alloy 82/182 dissimilar metal weld (DMW) with full structural weld overlays (SWOL) using PWSCC resistant

[] The planned mitigation using [] SWOL is a preemptive measure to reduce the PWSCC susceptibility of the DMW.

A weld residual stress (WRS) finite element analysis for the pressurizer safety/relief nozzle is performed to develop WRS distributions in support of the fracture mechanics analysis of postulated flaws in the DMW and the stainless steel weld (SSW) between the safe end and piping.

2.0 ANALYTICAL METHODOLOGY

The WRS finite element analysis is carried out per the Reference [1] WRS analysis procedure. The various stages of the welding processes for the structural components, the weld repair, and the SWOL, including the intervening load histories, are simulated in the finite element analysis using the following sequential steps:

1. Welding of the stainless steel safe end to the pressurizer safety/relief nozzle using Alloy 82/182 weld metal.
2. Removal of weld material from the inner surface of the DMW and replacement of the cavity with Alloy 182 weldment to simulate a weld repair.
3. Welding of the liner to the inside surface of the nozzle.
4. Simulation of hydro test.
5. Welding of the stainless steel pipe to the safe end using a stainless steel weld metal.
6. Simulation of hydro test.
7. Simulation of operational loads.
8. Welding of an [] SWOL onto the outer surface, covering the nozzle, the DMW, and the stainless steel weld.
9. Simulation of operational loads.

Figure 1 to Figure 5 illustrate these stages.

The general purpose finite element code ANSYS [2] is used to perform the WRS finite element analysis. The finite element analysis is based on a two-dimensional axisymmetric model. The basic steps comprising the multi-pass welding simulation of the DMW, the weld repair, the stainless steel weld, and the SWOL are as follows:

- Develop the finite element model considering features necessary to accommodate weld pass deposition and weld repairs.
- Define the temperature range for melting (solidus and liquidus temperatures).
- Define thermal and mechanical temperature dependent material properties from room temperature up to and including the melting region.
- Define thermal and structural boundary conditions.
- Define volumetric heat sources from welding procedure specifications.

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- Thermal phase using the ANSYS “birth and death” feature
 - Deactivate finite elements in all weld passes.
 - Activate one weld pass at a time and perform transient thermal analysis to develop the history of the temperature field for subsequent structural analysis.
- Structural phase using the ANSYS “birth and death” feature
 - Deactivate elements in all weld passes.
 - Activate one weld pass at a time and perform static structural elastic-plastic analysis using the temperature history from the thermal phase.
- Perform additional static load steps to simulate hydrostatic testing, steady state operation, and thermal cycling.

3.0 KEY ASSUMPTIONS

There are no major assumptions for this calculation. Minor assumptions are noted where applicable.

4.0 DESIGN INPUT

4.1 Geometry

The detailed dimensions of the safety/relief nozzle design and SWOL modeled in the WRS finite element analysis are obtained from [3] and [4] and are shown in Table 4-1.

Table 4-1: Dimensions of Safety/Relief Nozzle Design and SWOL

Component	Dimension
Pipe ID	[]
Pipe OD	[]
Safe End ID at SS Weld	[]
Nozzle ID	[]
Nozzle OD at Weld	[]
Nozzle OD (near head)	[]
Min Weld Overlay Thickness (at nozzle side)	[]

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4.2 Finite Element Model

The finite element model is a two-dimensional axisymmetric model. The finite element mesh consists of ANSYS four-node thermal (axisymmetric PLANE55) and structural (axisymmetric PLANE182) elements. The B-bar method of selective reduced integration is used for the structural elements in order to avoid mesh locking due to near incompressibility condition at large plastic strains. The weld pass depositions are simulated using ANSYS' element "birth and death" feature.

The finite element mesh for the safety/relief nozzle design and SWOL is shown in Figure 6. The DMW and stainless steel welds are sufficiently separated from the boundaries of the model that the "end effects" do not significantly affect stresses in the welds. The dimensions of the finite element model are developed per drawings [3] and [4]. The weld passes employed in the DMW, the weld repair, the stainless steel weld, and the SWOL are shown in Figure 7, Figure 8, and Figure 9, respectively.

4.3 Materials

Reference [5] provides the component material designation of various components modeled in the WRS analysis, as summarized in Table 4-2.

Table 4-2: Component Material Designation

Component	Material Designation
Nozzle	[]
Safe End	[]
Nozzle to Safe End Weld	[]
Buttering Weld	[]
Liner SA-213	[]
Pipe	[]
Safe End to Pipe Weld	[]
Weld Overlay	[]

The analysis herein uses the physical properties (thermal conductivity, specific heat, mean coefficient of thermal expansion, density, Young's modulus, and Poisson's ratio) and the stress-strain curves from Reference [6] that are representative of the materials in Table 4-2. All of the physical and mechanical properties, except the Poisson's ratio, are temperature dependent.

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The multi-linear kinematic hardening model in ANSYS is employed in the elastic-plastic structural analysis. Temperature dependent, true stress-strain material properties are used with the multi-linear kinematic hardening model for simulating the structural phase of the welding procedure.

4.4 Welding Parameters

The welding parameters used in the modeling of the welding processes are shown in Table 4-3.

Table 4-3: Welding Parameters

Welding Parameter	Value
<i>Groove weld heat input calculated from typical welding parameters for a manual metal arc or manual gas shielded tungsten arc weld</i>	
Current	[]
Voltage	[]
Travel Speed	[]
Arc Efficiency	[]
Bead Size	[]
Maximum Interpass Temperature	[]
<i>Overlay weld heat input</i>	
Heat Input [7]	[]
Arc Efficiency (typical)	[]
Bead Size, typically []	[]
Maximum Interpass Temperature [7]	[F]

4.5 Boundary Conditions

4.5.1 Thermal Analysis

The thermal model is loaded by a volumetric heat source applied to each weld pass. To enforce thermal continuity with adjacent components, adiabatic boundary conditions are applied at the nozzle end (where it attaches to the vessel) and at the end of the piping section modeled. Thus no heat transfer occurs through the two ends of the model shown in Figure 6. Heat loss at the inner and outer surfaces is simulated using a heat transfer coefficient of [] BTU/hr-ft²-°F per the Reference [1] WRS procedure to model natural convection to an air environment. Radiative boundary conditions are not considered since radiation losses from the molten weld pool are included in the weld efficiency.



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4.5.2 Structural Analysis

The temperature history from the thermal analysis is used as the thermal load in the structural analysis. A traction free boundary condition is maintained on all external surfaces of the finite element model. The finite element model is constrained against rigid body translation and rotation by eliminating axial displacements at the nozzle end.

5.0 FINITE ELEMENT RESULTS/SUMMARY

Following the completion of the SWOL simulation, two operating load cycles were applied to the finite element model to obtain a stable state of residual stress after shakedown. This stress state is referred to as shutdown at 70°F. The axial and hoop stress contours at shutdown are shown in Figure 10. Following shutdown, an additional half cycle of operating loads were applied to the finite element model to obtain the sustained stresses under steady state condition at [] °F. Figure 11 shows the axial and hoop stress contours at steady state.

PWSCC is only a concern when the conditions of high temperature, corrodant, and high tensile stress state in a susceptible material are met simultaneously. Alloy 82/182 is a material that is susceptible to PWSCC. The operating temperature of the pressurizer safety/relief nozzle design is conducive to PWSCC.

Figure 14 shows the steady state axial and hoop stress distributions along a path line ("IDSURF1") at the DMW inner surface. Figure 15 shows the steady state axial and hoop stress distributions along a path line ("IDSURF2") at the inner surface of the liner weld and safe end. These path lines (shown in Figure 12) include the surfaces of the nozzle, the butter, the repair weld, the DMW, liner weld and the safe end. It is seen that the axial and hoop stresses are all compressive along the inner surface of the DMW region, thus showing the effectiveness of the SWOL as a preemptive measure to reduce the PWSCC susceptibility of the DMW.

The through-wall axial and hoop stress distributions, along three path lines in the DMW region and one path line in the SSW, at shutdown are shown in Figure 16 and Figure 17, respectively. These path lines are defined in Figure 13. These axial and hoop stress distributions at shutdown are part of the sources of stress to be used in fatigue crack growth evaluations. They are tabulated in Appendix A.

The through-wall axial and hoop stress distributions at steady state are given in Figure 18 and Figure 19 respectively, using the same path lines defined in Figure 13. These axial and hoop stress distributions at steady state are part of the required stress input to the PWSCC crack growth evaluations. They are also tabulated in Appendix A.

6.0 REFERENCES

1. AREVA NP Document 32-2500013-001, "Technical Basis for Numerical Simulation of Welding Residual Stresses"
2. "ANSYS" Finite Element Computer Code, Version 10.0, ANSYS Inc., Canonsburg, PA
3. AREVA NP Drawing 02-8018401C-001, "Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Existing Configuration"
4. AREVA NP Drawing 02-8019311D-001, "Diablo Canyon Pressurizer Safety/Relief Nozzle Weld Overlay Design Input"
5. AREVA NP Document 08-9042937-003, "Pressurizer Nozzle Weld Overlays at Pacific Gas and Electric Diablo Canyon Nuclear Power Plant, Unit 2 – Certified Design Specification"
6. AREVA NP Document 32-2500012-002, "Materials Database for Weld Residual Stress Finite Element Analyses."
7. AREVA NP Document 55-WP3-8-F43OLTBSCa3-005, "Welding Procedure Specification."

7.0 COMPUTER OUTPUT

The computer output files that support the fracture mechanics analysis are listed in Table 7-1.

Table 7-1: Computer Output Files for Fracture Mechanics Analysis*

File Name	Date	Description
SrvSD2_AXIAL.out	5/31/2007	Axial stress along all four path lines at shutdown (70°F)
SrvSD2_Hoop.out	5/31/2007	Hoop stress along all four path lines at shutdown (70°F)
SrvSD2_Locs.out	5/31/2007	Path coordinates for all four path lines at shutdown (70°F)
SrvHU3_AXIAL.out	5/31/2007	Axial stress along all four path lines at steady state ([] °F)
SrvHU3_Hoop.out	5/31/2007	Hoop stress along all four path lines at steady state ([] °F)
SrvHU3_Locs.out	5/31/2007	Path coordinates for all four path lines at steady state ([] °F)
Vm32-Modified.vrt	5/30/2007	Verification Case for elements Plane 55 and Plane 182 through axisymmetric analysis of thermal stresses in an infinitely long cylinder.
Vm38-Modified.vrt	5/30/2007	Verification Case for element Plane 182 through axisymmetric analysis of elastic plastic problem of an infinitely long cylinder under pressure.

*** Note: The computer output from Revision 000 of this document is unchanged and remains applicable to Revision 002. It is therefore not attached to Revision 002. The list of computer output is provided for information only.**

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8.0 FIGURES SECTION

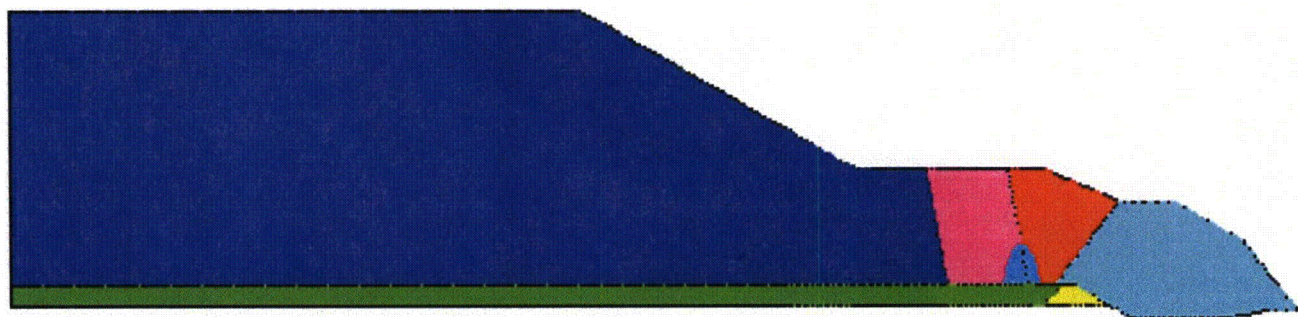
Figure 1: Welding of the stainless steel safe end to the pressurizer safety/relief nozzle using Alloy 82/182 weld metal



Figure 2: Removal of weld material from the inner surface of the DMW and replacement of the cavity with Alloy 182 weldment to simulate a weld repair



Figure 3: Welding of the liner to the inside surface of the nozzle



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Figure 4: Welding of the stainless steel pipe to the safe end using stainless steel weld metal

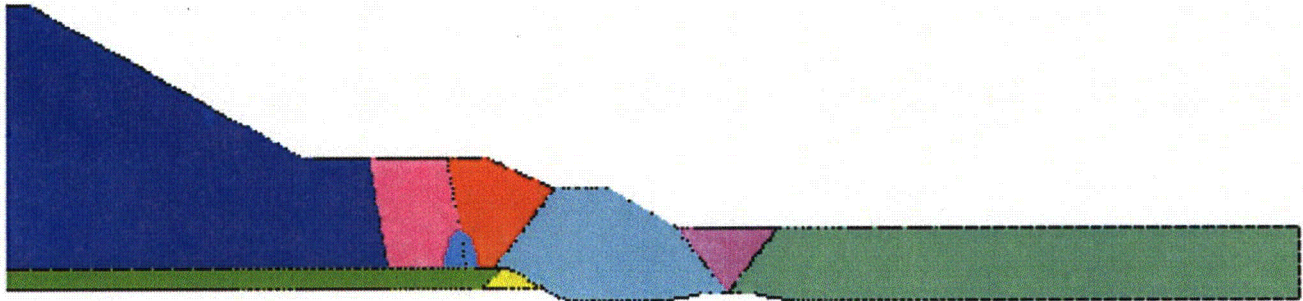


Figure 5: Welding of an [] SWOL onto the outer surface, covering the nozzle, the DMW, and the stainless steel weld

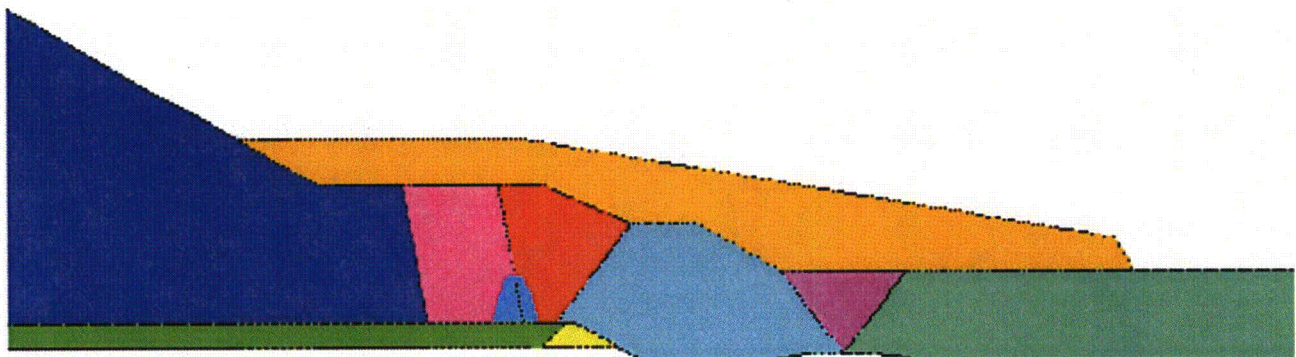


Figure 6: Finite element mesh for the safety/relief nozzle design and SWOL

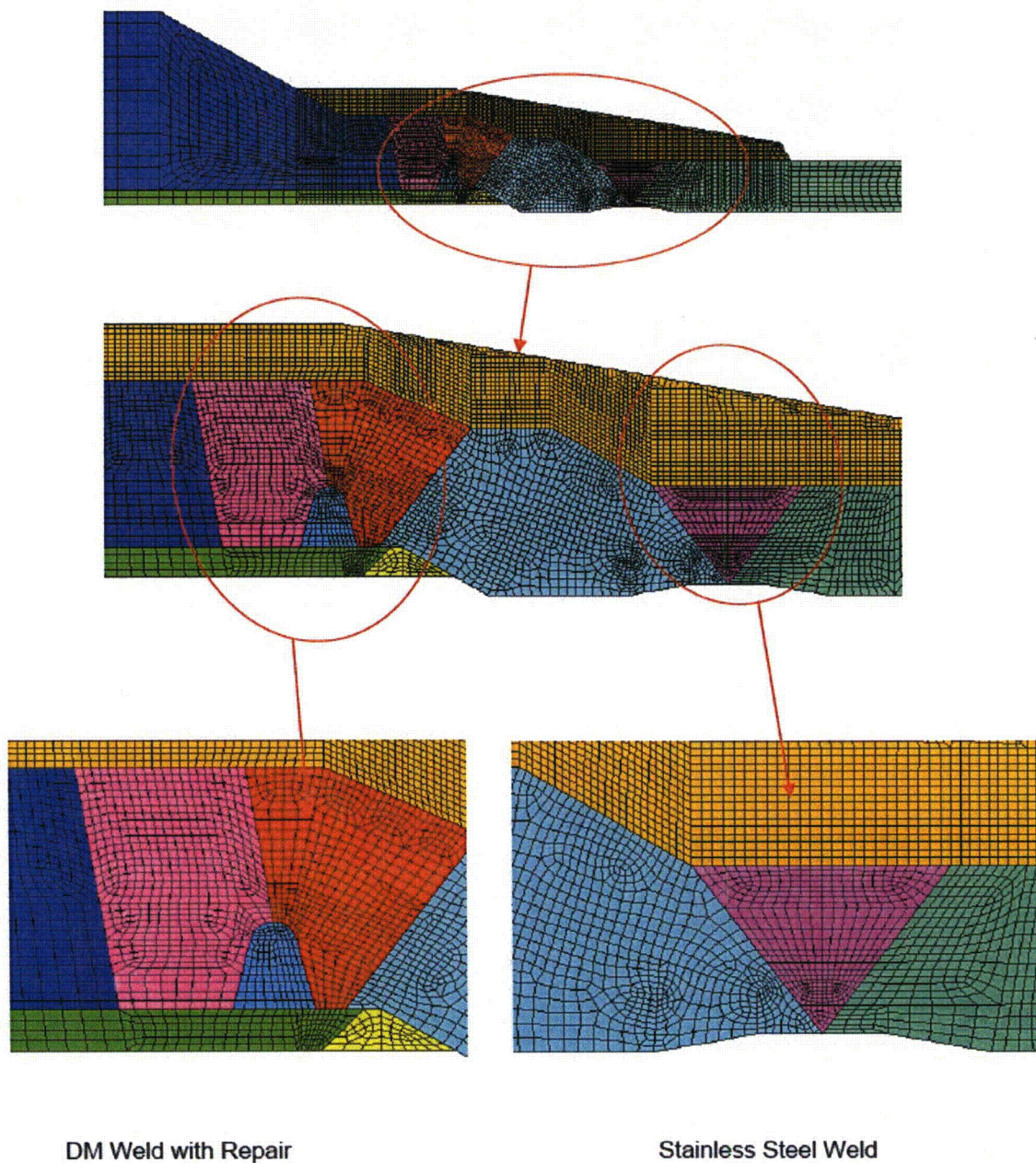


Figure 7: Weld passes employed in the DMW

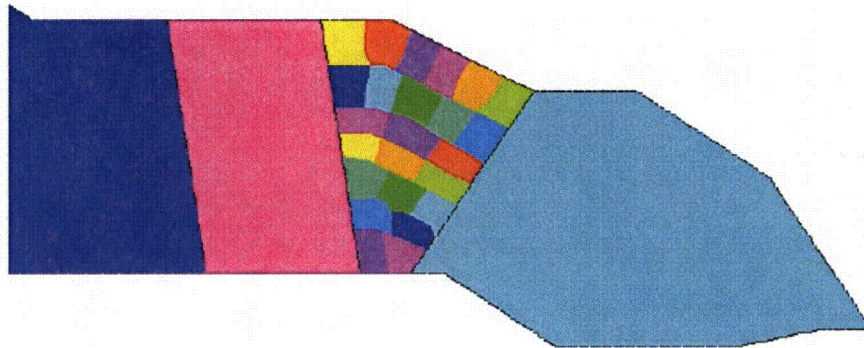


Figure 8: Weld passes employed for the weld repair and in the stainless steel weld

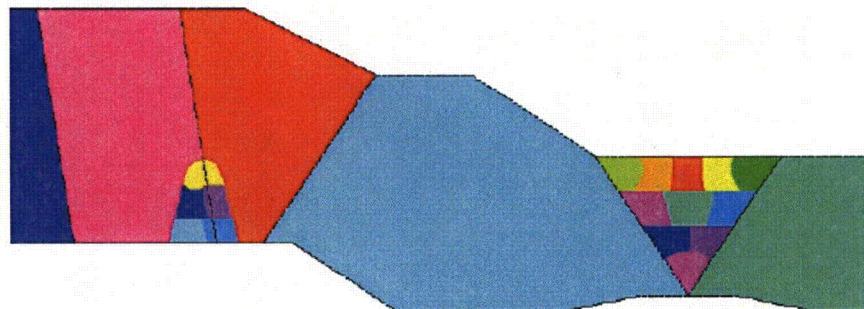
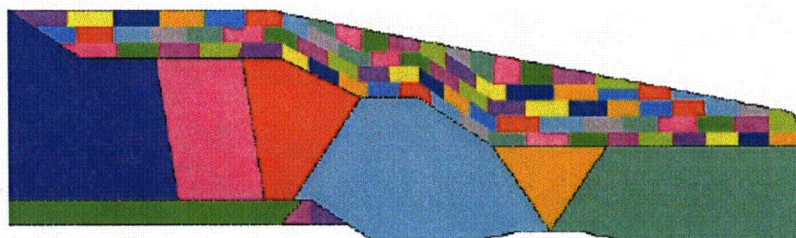
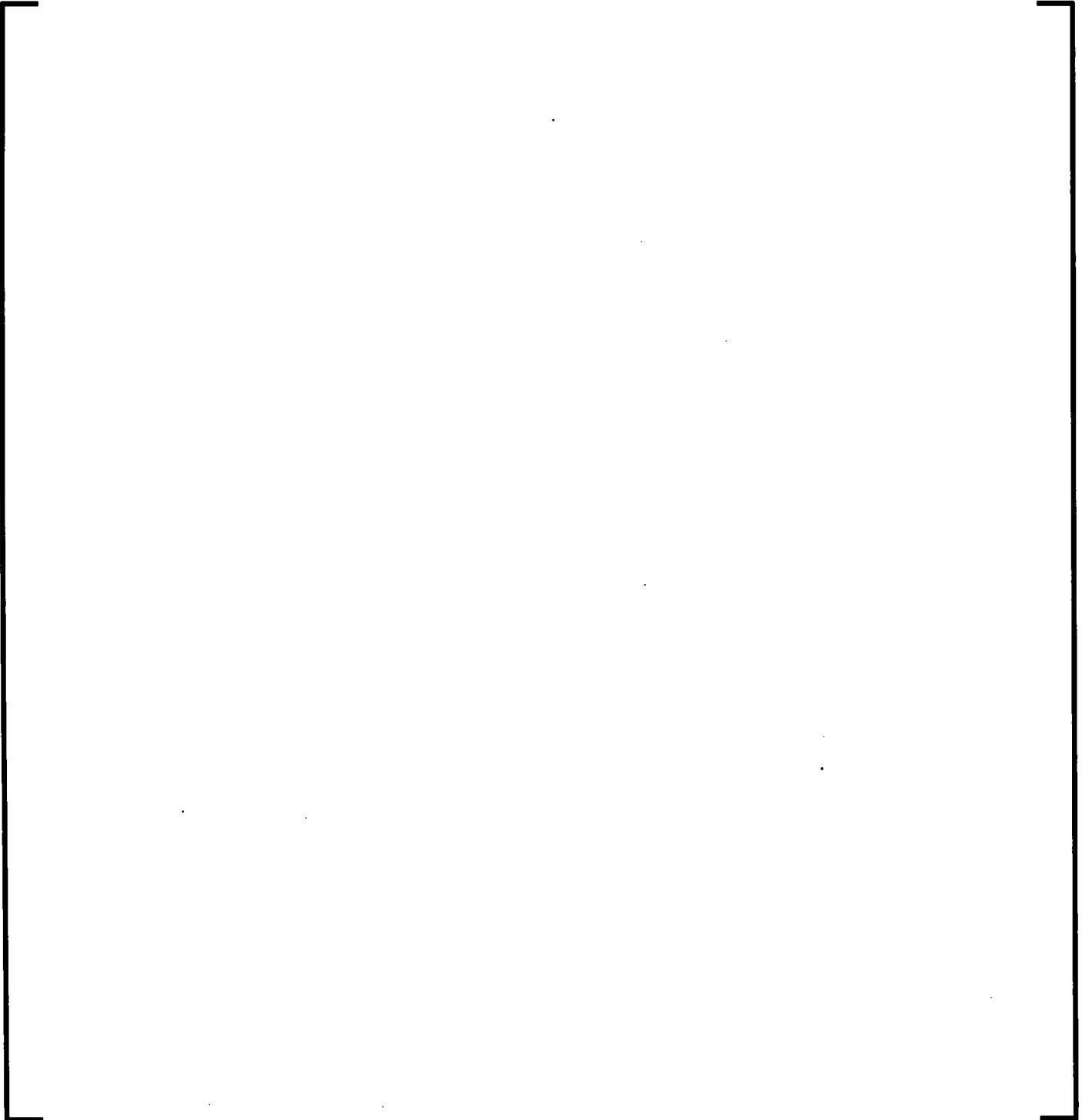


Figure 9: Weld passes employed in the SWOL and liner weld



Diablo Canyon Unit 2 Pressurizer Safety/Relief Nozzle Weld Overlay Residual Stress Analysis – Non-Proprietary

Figure 10: Axial and hoop stress contours at shutdown (70°F) obtained by applying two operating load cycles following the completion of the SWOL



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Figure 11: Axial and hoop stress contours at steady state ([] °F) obtained by applying two-and-a-half operating load cycles following the completion of the SWOL

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Figure 12: Path lines for axial and hoop stress distributions along the ID surfaces

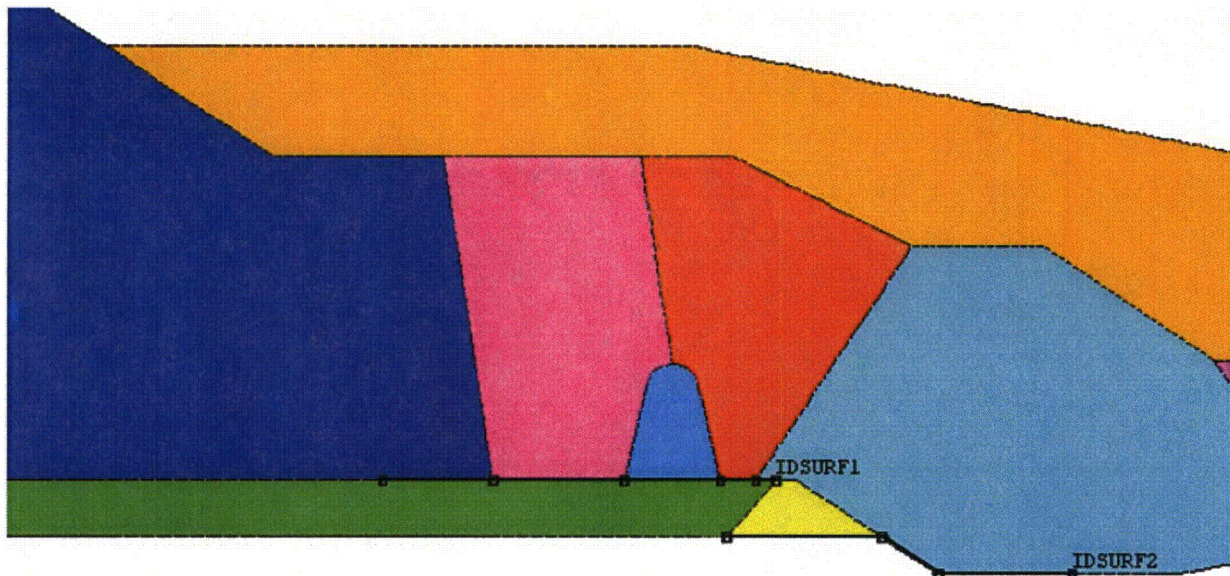
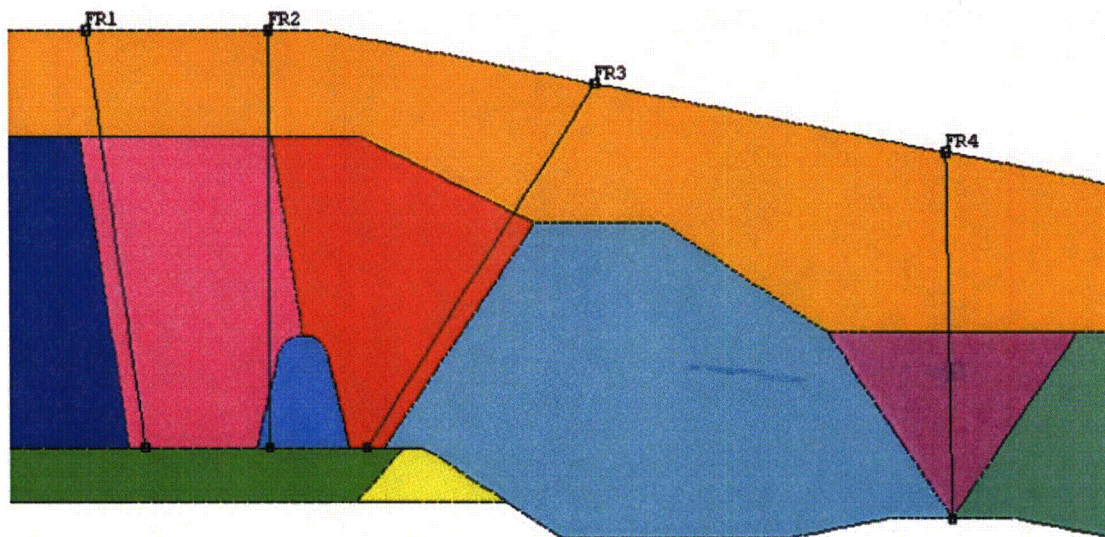


Figure 13: Path lines for the through-wall axial WRS distribution in the DMW region and the stainless steel weld

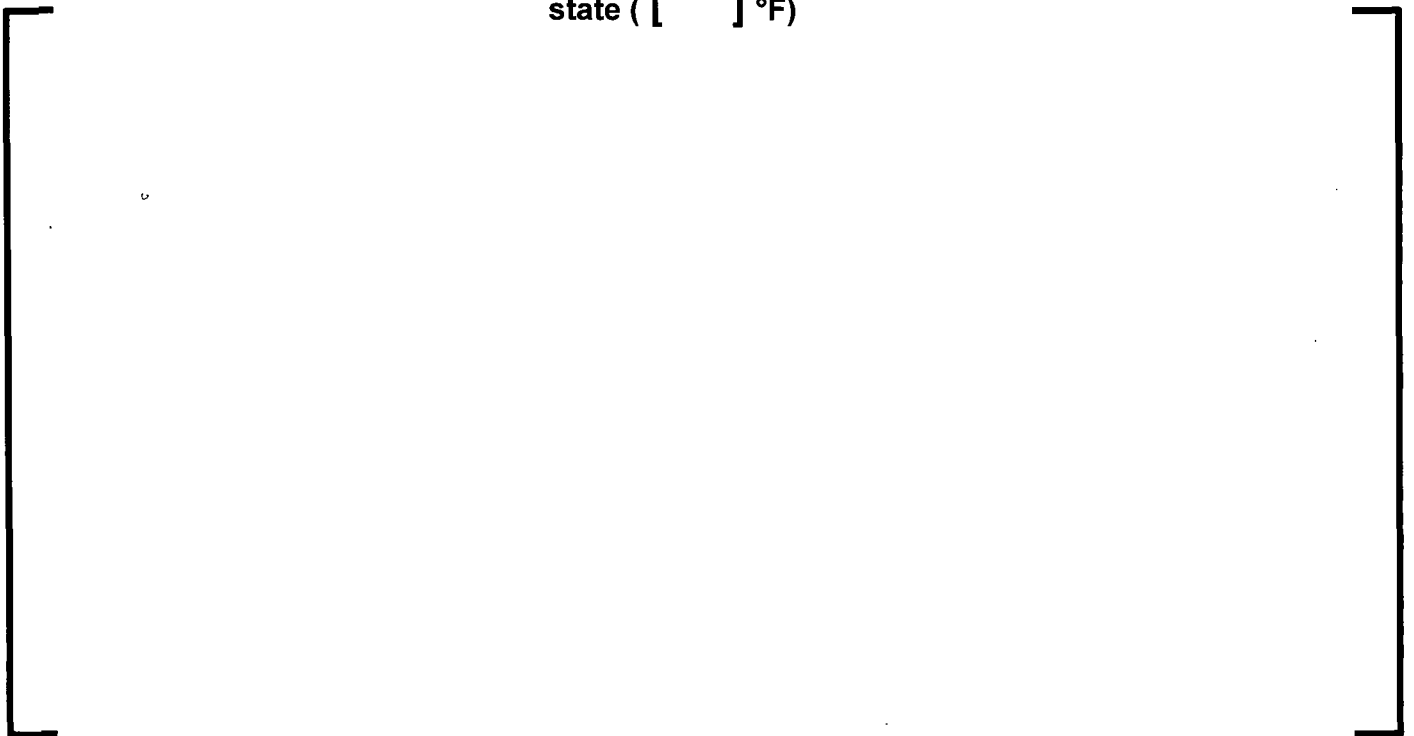


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**Figure 14: Axial and hoop stress distributions along the DMW ID surface at steady state
([] °F)**



Figure 15: Axial and hoop stress distributions along the liner weld ID surface at steady state ([] °F)

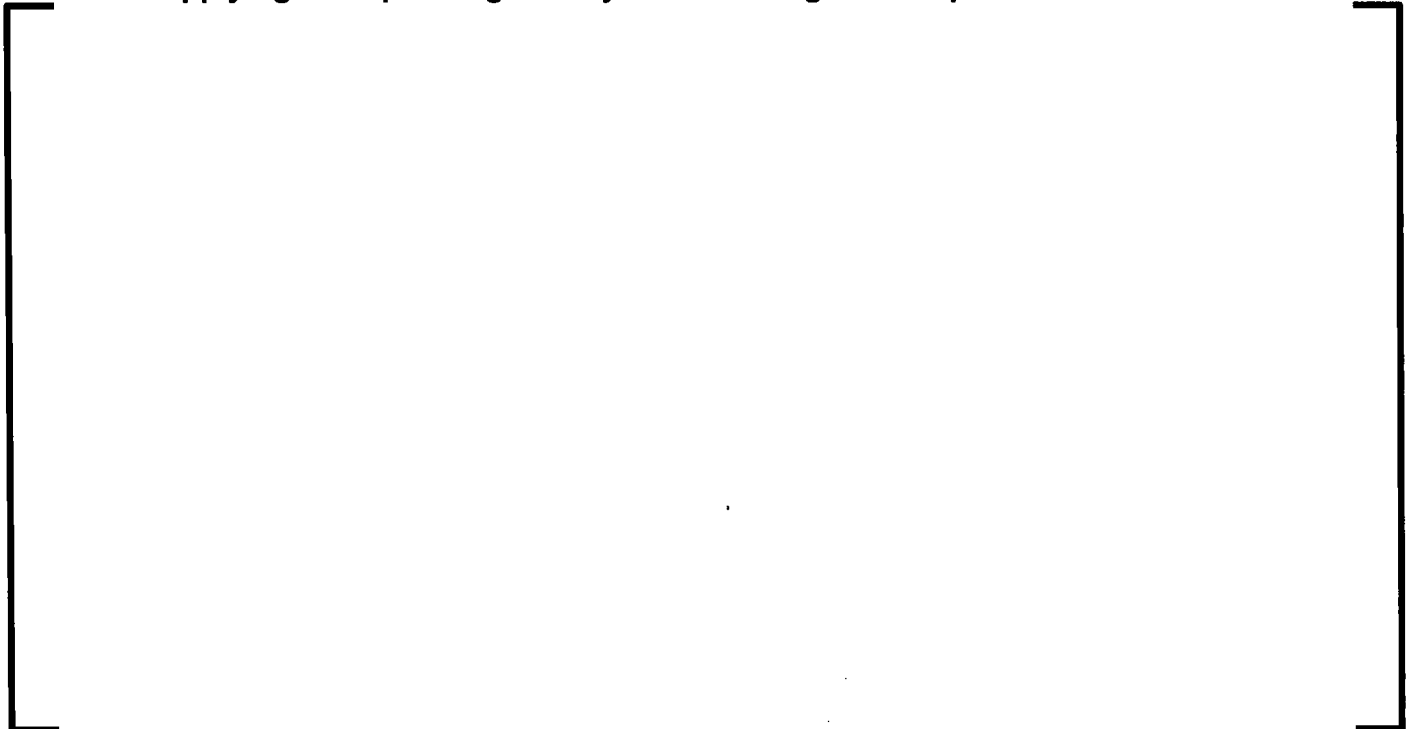


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Figure 16: Through-wall axial stress distributions at shutdown (70°F) obtained by applying two operating load cycles following the completion of the SWOL



Figure 17: Through-wall hoop stress distributions at shutdown (70°F) obtained by applying two operating load cycles following the completion of the SWOL

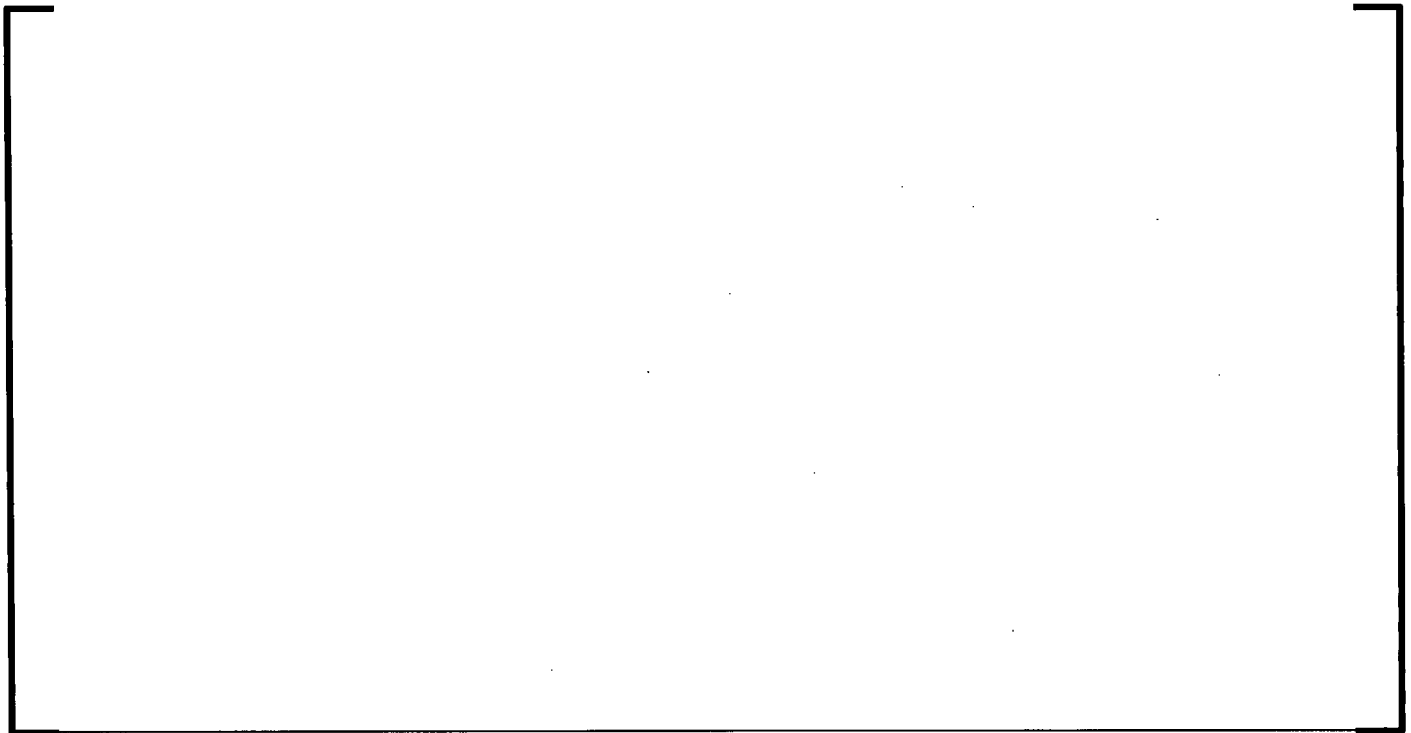


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Figure 18: Through-wall axial stress distributions at steady state ([] °F) obtained by applying two-and-a-half operating load cycles following the completion of the SWOL shutdown



Figure 19: Through-wall hoop stress distributions at steady state ([] °F) obtained by applying two-and-a-half operating load cycles following the completion of the SWOL





APPENDIX A: AXIAL AND HOOP STRESS TABLES

Figure 13 shows the path lines along which the stress results are obtained. The axial and hoop WRS distribution at the completion of the SWOL at shutdown and steady state operating conditions are listed in Table A-1 and Table A-2 respectively.

Table A-1: Through-wall axial and hoop stress distributions at shutdown (70°F)

Along Path Line "FR1"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR2"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR3"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR4"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR1"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR2"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR3"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

Along Path Line "FR4"		
Distance Along Path Line from the ID (in.)	Axial WRS (psi)	Hoop WRS (psi)

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APPENDIX B: VERIFICATION OF THE FINITE ELEMENT PROGRAM

The following two verification cases were run to verify that the finite element program ANSYS [2] executes properly. The two cases were selected to verify the elements used in the current analysis (plane 55 and plane 182) for the scope of the simulations used in this document, thermal stress analysis in an infinitely long cylinder and elastic plastic structural analysis in a cylinder. For the thermal stress analysis case, the standard ANSYS verification case (vm32) is setup to verify plane 55 (thermal) and plane 42 (structural). This case was modified to replace plane 42 structural element with plane 182. For the elastic plastic case, the ANSYS verification test case was setup to handle plane 42, this case was modified to verify the plane 182 element instead of the plane 42 structural element. The results of the verification cases are presented below:

----- VM32-Modified RESULTS COMPARISON -----

| TARGET | ANSYS | RATIO

THERMAL ANALYSIS:

T (C) X=.1875 in	-1.00000	-1.00000	1.000
T (C) X=.2788 in	-0.67037	-0.67039	1.000
T (C) X=0.625 in	0.00000	0.00000	0.000

PRINTOUT RESUMED BY /GOP
STATIC ANALYSIS:

A_STS psi X=.187	420.42	429.99	1.023
T_STS psi X=.187	420.42	429.61	1.022
A_STS psi X=.625	-194.58	-205.15	1.054
T_STS psi X=.625	-194.58	-205.08	1.054

----- VM38-Modified RESULTS COMPARISON -----

| TARGET | ANSYS | RATIO

FULLY ELASTIC, PLANE182 RESULTS:

SIGR LFT_END psi	-9984.	-10075.	1.009
SIGT LFT_END psi	18645.	18785.	1.008
SIGR RT_END psi	-468.	-478.	1.021
SIGT RT_END psi	9128.	9131.	1.000

FULLY PLASTIC, PLANE182 RESULTS:

SIGEFF L	30000.	31239.	1.041
SIGEFF R	30000.	30442.	1.015

This is modified from ANSYS VM38 case to verify the PLANE182
Element solving a problem of Long Cylinder under plastic
Pressure Load

APPENDIX C: STRESS FOR EVALUATING NDE INDICATIONS

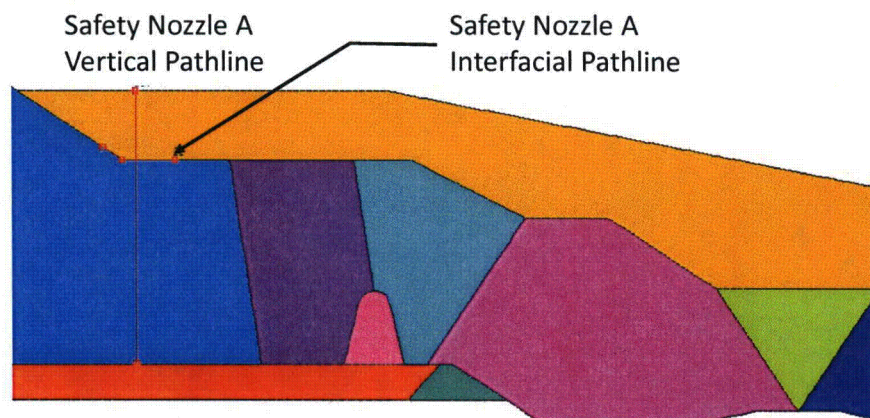
C.1 Purposes

The purpose of this appendix is to summarize residual stresses to support flaw evaluations of indications detected or assumed to exist based on the results of the 2013 seventeenth refueling outage (2R17) inservice inspection that are considered rejectable in the overlaid Pressurizer (PZR) Safety Nozzles of Diablo Canyon Power Plant (DCPP) Unit 2. The indications are reported in Reference [C1]. Results are provided along path lines that are located in close proximity to the found indications in the Safety/Relief nozzle.

C.2 Methodology

This revision provided only post processing of the database that was developed in the previous revision of the document. Path lines for obtaining the residual stresses were selected to best match the locations and sizes of the flaw indications as described in Reference [C1]. It should be noted that since the finite element is discrete and it does not exactly match the sketches of the Safety Nozzles provided in Reference [C1], the selected path lines location and sizes are only a best estimate representation of the indications locations and sizes. For every reportable indications two path lines were selected, an interfacial (horizontal path line) and a vertical path line. The interfacial path line is used to sample stresses to be used for evaluating a laminar flaw. Thus radial and shear stresses are of interest for the interfacial path line. The vertical path line is used to sample stresses to be used for evaluation any planar projection of the indications. Axial, hoop stresses, or both axial and hoop stresses may be used for evaluating the planar extent of the indications. The path lines investigated in this appendix are illustrated in Figure C-1 through Figure C-3. Since only Safety Nozzle "A" indication has planar component vertical pathline of only Safety Nozzle "A" will be required for further analysis. Stresses along vertical path lines B, C1 and C2 are included for information only.

Figure C-1: Safety Nozzle A Path lines



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Figure C-2: Safety Nozzle B Path lines

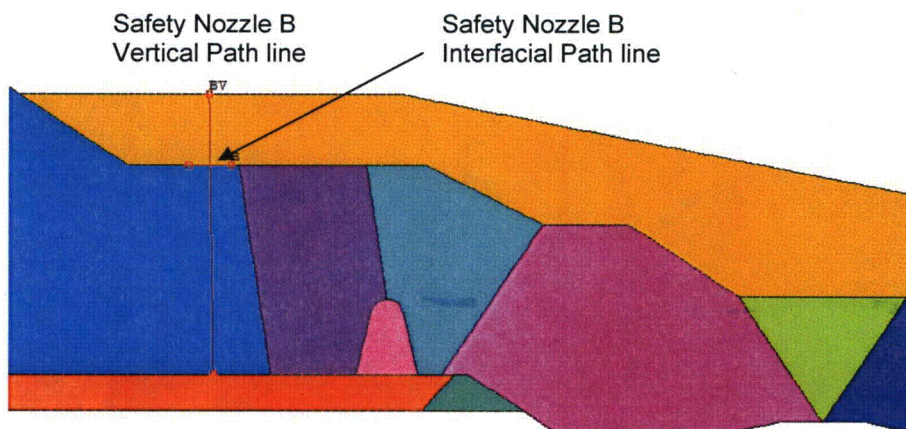
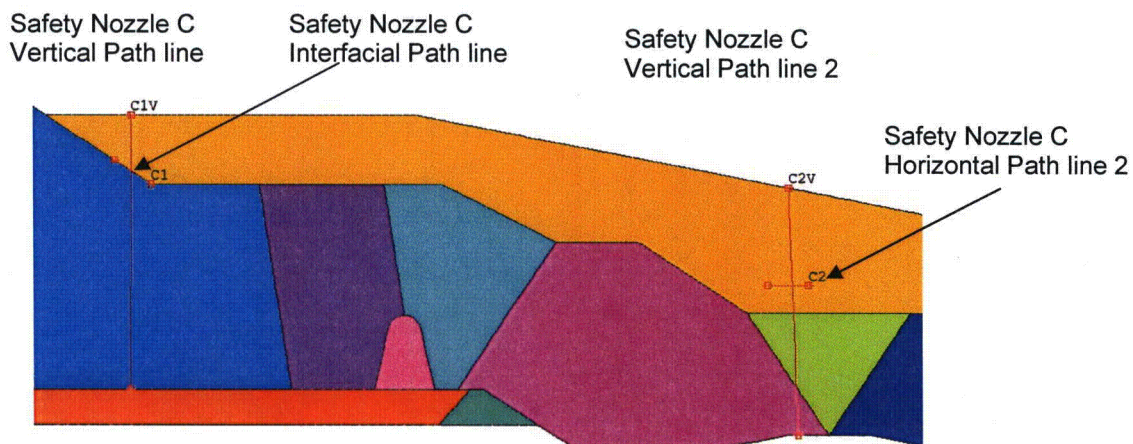


Figure C-3: Safety Nozzle C Path lines





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C.3 Results

Axial (SY), hoop (SZ), radial (SX), and shear (SXY) stresses are read from the database and the result files that were archived with the previous revisions of this document. To ensure that the stress sampling results in the most bounding stresses for the path lines located near the interface of the overlay and the original material (nozzle), the post processing for interfacial path lines was processed while selecting either the overlay material, the nozzle material, or both materials.

C.3.1 Interfacial Pathlines Results

As mentioned above, the interfacial path lines are of interest for evaluating laminar flaws. Thus, only the radial and shear stresses are of interests. As discussed before, for all interfacial path lines (except for Safety Nozzle C Interfacial Pathline 2, which is located entirely in the overlay), three post processing runs were performed by either selecting all materials, overlay material, or nozzle material. The results are documented in output files "SafetyRelief_pathsALL.out", "SafetyRelief_pathsOL.out", "SafetyRelief_pathsBASE.out". The results from the output files are manipulated in file "Results.xlsm" to select most bounding stresses. The minimum and maximum values of the radial and shear stresses are tabulated in Table C-1.

Table C-1: Bounding Radial and Shear Stresses for Interfacial Path lines

Nozzle Path line	Radial Stress (psi)		Shear Stress (psi)	
	Minimum	Maximum	Minimum	Maximum
Safety Nozzle A	[]	[]	[]	[]
Safety Nozzle B	[]	[]	[]	[]
Safety Nozzle C (1)	[]	[]	[]	[]
Safety Nozzle C (2)	[]	[]	[]	[]

C.3.2 Vertical Path lines Results

Vertical path lines are required for analyzing the planar flaws. Only axial and hoop stresses are of interest in the analysis. The post processing was performed by selecting all materials. The results are documented in output files "SafetyRelief_pathsALL.out". The hoop and axial stresses are tabulated below in Table C-2. Since only Safety Nozzle "A" indication has planar component only Path line "A" stresses will be required for further analysis. Stresses along path line B, C1 and C2 are for information only.

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Table C-2: Through-wall axial and hoop stresses for vertical path lines at shutdown (70°F)

Along Path Line "A"		
Distance Along Path Line from the ID (in.)	Hoop WRS (psi)	Axial WRS (psi)

Along Path Line "B" (For information only)		
Distance Along Path Line from the ID (in.)	Hoop WRS (psi)	Axial WRS (psi)

Along Path Line "C1" (For information only)		
Distance Along Path Line from the ID (in.)	Hoop WRS (psi)	Axial WRS (psi)

Along Path Line "C2" (For information only)		
Distance Along Path Line from the ID (in.)	Hoop WRS (psi)	Axial WRS (psi)

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C.4 Computer Usage**C.4.1 Software and Hardware**

ANSYS Version 14.0 [C2] was used in this calculation. Verification test cases were performed and documented herein.

- Computer program tested: ANSYS Version 14.0, verification tests vm32mod2D.vrt and vm38mod2D.vrt.
- Error notices for ANSYS Version 14.0 were reviewed and none apply for this analysis.
- Computer hardware used: The computer hardware used in the analysis is DELL (Service Tag # 5VKW5S1). The hardware platform is Intel® Core™ i7-2640M CPU @ 2.8 GHz, 8 GB RAM and operating system is Microsoft Windows 7 Enterprise x 64 Edition, Version 2009, and Service Pack 1.
- Name of person running the test: Silvester Noronha
- Date of test: 11-05-2013
- Acceptability: For ANSYS 14.0 cases vm32mod2D, vm38mod2D, obtained from Reference [1] are run to verify that the answers are correct. The files vm32mod2D.vrt and vm38mod2D.vrt contain output from the test cases. Review of the output shows that the answers are identical to those contained in Reference [1].

C.4.2 Computer Files

All ANSYS input/output files are collected and listed in Table C-3. All computer runs and post processing along with post processing macros are documented in the ColdStor storage path "\cold\General-Access\32\32-9000000\32-9049062-003\official". ANSYS verification input/output files are also listed.

Table C-3: Computer Files

Name	Size	Date/Time Modified	Checksum
PostProcessSafetyAll.inp	4168	Nov 04 2013 11:05:26	16117
PostProcessSafetyBase.inp	4171	Nov 04 2013 14:38:55	13367
PostProcessSafetyOL.inp	4165	Nov 04 2013 14:38:40	64989
SafetyRelief_pathsALL.out	12056	Nov 04 2013 13:40:51	33139
SafetyRelief_pathsBASE.out	12059	Nov 04 2013 14:41:17	34886
SafetyRelief_pathsOL.out	12053	Nov 04 2013 14:40:03	57649
Results.xlsx	52148	Nov 14 2013 16:38:08	09536
vm32mod2D.inp	3551	Jan 05 2009 10:09:26	30336
vm32mod2D.vrt	624	Nov 05 2013 09:55:59	17780
vm38mod2D.inp	2458	Jan 07 2009 11:28:06	51869
vm38mod2D.vrt	650	Nov 05 2013 09:56:31	36343

C.5 References

- C.1. AREVA Document 38-9200149-001, (DCPP Unit 2 DIT-50540188-04-00), "DCPP Unit 2 Pressurizer Nozzle NDE Data"
- C.2. ANSYS Finite Element Computer Code, Version 14.0, ANSYS Inc., Canonsburg, PA